Selective heating and drug delivery is also possible with PREs. If PREs are localized in a selected tissue or region of a patient, they can be illuminated so as to locally heat the tissue or region without significant affect on neighboring areas of the body. The administration and activation of light activated drugs is also enhanced with PREs. Light activated drugs can be activated with far less total light energy by being bound to a PRE where the electric field will be enhanced. The use of light activated drugs to treat breast cancer has received recent attention, and may be improved by binding the drugs to PREs to enhance their activation at locations deeper in the tissue.

The application of optical PRE detection and analysis to biochemical systems is considered to provide many advantages over current labeling techniques, and appears to comprise an area where PRE analysis can have a large impact. Other areas, however, may also benefit from the PRE detection and spectral analysis of the present invention.

From the foregoing, it will be appreciated how various objects and features of the invention have been met. The method and apparatus of the invention are ideally suited to a variety of target-interrogation tasks that have been difficult or impossible heretofore, including, as representative examples:

1. detecting single molecule events;
2. resolving sub-wavelength distance relationships in a biological target in a natural hydrated state;
3. direct spatial mapping of selected target sites on a biological target, such as direct mapping of selected sequences in a chromosome for purposes of chromosome mapping; and
4. optical reading of microencoded information;

The method and apparatus can further be applied to a wide variety of diagnostics applications, to achieve improved sensitivity, spatial and distance information, ease of sample preparation, and flexibility in the type of target sample that can be interrogated.

Although the present invention has been described with respect to particular methods, compositions, and devices. It will be appreciated that various changes and modifications can b made without departing from the invention.

What is claimed is:

1. A method of interrogating a field having a plurality of plasmon or resonant entities (PREs) distributed therein, comprising;

illuminating the field with an optical light source,

detecting a spectral emission characteristic of individual PREs and other light scattering entities in the field,

constructing a computer image of the positions and values of the emission spectral characteristic of individual PREs and other light-scattering entities present in the field, and

discriminating PREs with a selected spectral signature from other light-scattering entities based on detected spectral characteristic values unique to the selected-signature PREs, to provide information about the field.

2. The method of claim **1**, wherein said detecting includes simultaneously detecting the spectral emission characteristic of the light-scattering entities in the field.

3. The method of claim **2**, wherein said detecting further includes detecting the spectral emission characteristic of the light scattering entities in the field simultaneously at a plurality of defined spectral frequencies.

4. The method of claim **1**, wherein said illuminating and detecting steps include:

illuminating said PREs with incident light predominantly in a first frequency band;

detecting the spectral emission characteristics of individual PREs and other light scattering entities in the field under illumination at the first frequency band;

illuminating said PREs with incident light predominantly in a second frequency band; and

detecting the spectral emission characteristics of individual PREs and other light scattering entities in the field under illumination at the second frequency band.

5. The method of claim **1**, wherein said detecting includes sequentially detecting the spectral emission characteristic of individual PREs and other light scattering entities in the field at a plurality of defined spectral bands.

6. The method of claim **1**, wherein said illuminating includes exposing the field to a plurality of narrowband pulses of light which vary in duration, and said detecting includes detecting variations in emitted light intensity produced by variations in duration.

7. The method of claim **1**, wherein at least some of the PREs are non spherical, said illuminating includes exposing the field to polarized light at different orientations and/or different angles of incident, and said discriminating includes detecting changes in a spectral emission characteristic as a function of incident light polarization orientation or angle.

8. The method of claim **1**, wherein said PREs are formed in the field by a step selected from the group consisting of:

(i) binding nucleation centers to a field, metal enhancing said nucleation centers, observing enhancement of said nucleation center during said metal enhancing process, and terminating enhancement when a PRE of a desired spectral characteristic has been formed;

(ii) adding pre-formed PREs to a target in the field,

(iii) making PREs at target sites in the field.

9. The method of claim **1**, wherein discriminating PREs with a selected spectral signature from other light-scattering entities in the field includes discriminating a selected type of PRE from all other light-scattering entities in the field, based on detected values, for each light-scattering entity in the field, of peak position, peak intensity, or peak width at half intensity of the spectral emission curve, peak halfwidth in the image plane, and polarization or angle of incidence response.

10. The method of claim **9**, wherein said discriminating is effective to discriminate, for a selected type of PREs, those selected PREs which are interacting with one another and those which are not.

11. The method of claim **9**, wherein said discriminating is effective to discriminate a selected type of PRE from another selected type of PRE in the field.

12. The method of claim **1**, wherein the PREs have surface-localized fluorescent molecules or Raman-active molecular entities, and said detecting includes detecting plasmon-resonance induced fluorescent emission or Raman spectroscopy emission from one or more of said molecules or entities, respectively.

13. The method of claim **1**, for use in determining the total number of PREs of a selected type in a field, wherein said discriminating includes counting the number of PREs having a selected range of values of a selected spectral emission characteristic in the constructed computer image.

14. The method of claim **1**, for use in determining a spatial pattern of PREs having a selected range of values of a selected spectral characteristic in the field, wherein discriminating includes constructing an image of the relative locations of PREs with those spectral-characteristic values.

15. The method of claim **14**, wherein the location between two adjacent PREs is less than the Rayleigh resolution